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(71) Applicant: Exxon Research and Engineering Company
P.O.Box 390 200 Park Avenue
Florham Park New Jersey 07932(US)

(72) Inventor: Moss, Gerald Dr.
"Trevose" Sarajac Avenue
East Challow Wantage Oxfordshire(GB)

(74) Representative: Field, Roger Norton et al.
5 Hanover Square
London W1R OHQ(GB)

(54) Heat exchanger.

(57) A heat exchanger comprising a heat-conducting structure (2), e.g. sheet, supporting a continuous heat-conducting pipework (4) e.g. of serpentine shape, through which liquid can pass. There are ducts with pervious walls (3) spaced from and adjacent to the pipework (4). Solid material (5) is housed adjacent to but external of the ducts (3).

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EP 0 052 422 A2

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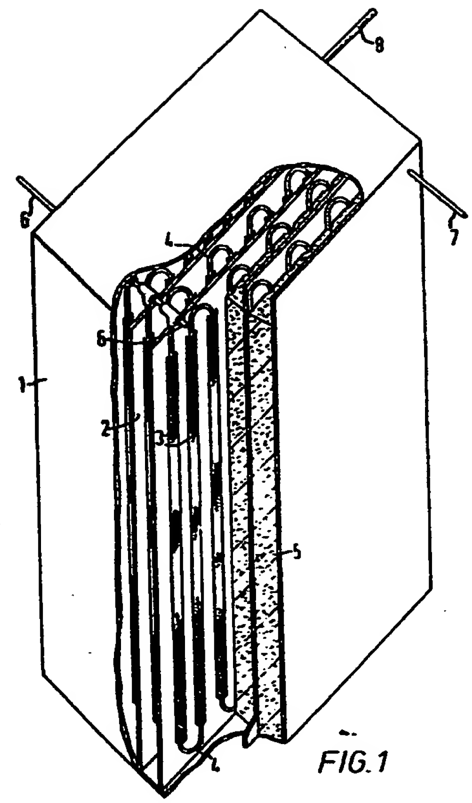

FIG.1

Heat Exchanger

This invention related to heat exchangers suitable for use in systems using an adsorber as a source of heat.

When using an adsorber there are two problems to be overcome to ensure that the adsorption heat generator will have adequate load following characteristics. There must be free access for adsorbate vapour to contact the bulk of the adsorbent so that the heat rate limitations imposed by the vapour diffusion rates are minimised and the length of the heat transmission path through the adsorbent must be short enough to ensure that the adsorption and the heat release rates are not temperature limited.

These problems may be solved by using the heat exchanger of this invention. This comprises a continuous pipework through which liquid can pass, the pipework being supported on a structure and provided with ducts with pervious walls spaced from and adjacent to the pipework. There are also means capable of housing solid material adjacent to, but external of these ducts. The pipework and structure are made of heat conducting material, e.g. a metal such as copper or aluminium.

The pipework is supported on a heat conducting structure and this is preferably a sheet, strip or plate. It is convenient for the pipework to be soldered or welded onto this structure e.g. sheet. However if desired this structure e.g. sheet may be made with expanded sections which form liquid-tight conduits therein and hence constitute the pipework. It is essential that the structure itself is also made of heat conducting material, e.g. a metal such as copper or aluminium.

The configuration of the pipework can vary, but usually it is of a serpentine shape, whereby if a structure, e.g. sheet, is used it is substantially covered with pipework. When installed for use it is preferred that the axes of the bulk of the pipework are substantially vertical.

Spaced from and adjacent to the pipework are ducts with pervious walls. These ducts can for example be perforated strips or wire mesh. Other examples are porous plastics or metals. Preferably the ducts are made of heat conducting material, e.g. copper or aluminium.

If the supporting structure together with the pipework forms a continuous surface as in the case where the structure is a sheet or strip, then the ducts need only be attached to one surface of the structure. These ducts can conveniently be half-cylinders or be U-shaped or rectangular or square in cross-section. Together with the structure they will form a pervious passageway surrounding the pipework.

These ducts can be attached to the supporting structure by for example welding, soldering or glue such as epoxy resin adhesive, etc.

Generally, substantially all the pipework has pervious ducts associated therewith. Thus, in the case of a serpentine pipework only the curved ends will not be provided with pervious ducts.

The means capable of housing solid material adjacent to, but external of the ducts can take various forms. One particularly convenient form is provided by the use of a plurality of structures in the form of sheet, strips or plates substantially parallel to each other housed in a container. The structures are placed substantially vertically in the container substantially parallel to one another and the solid material is housed between each structure and supported by the bottom of the container. Some of the solid material is of course housed between the side walls of the container and the structure immediately adjacent to the side walls of the container. In such cases, the surfaces of the structures having the pipework attached thereto, will usually but not necessarily face in the same direction.

Alternatively, separate containers could be attached to each sheet, strip or plate so that solid material can be housed adjacent to each duct.

Another particularly suitable form is provided by the use of a structure in the form of a spiral sheet housed in a container. This sheet is a continuous spiral, one face of which is provided with a continuous pipework surrounded by a series of pervious ducts. The space in between is used to house the solid material which is supported by the bottom of the container.

In cases where there is more than one structure then it is preferred that the pipework associated with each structure be connected in parallel, e.g. by manifolds, connected respectively to the inlet ends and to the outlet ends of each pipework.

When using a plurality of structures or using a structure in the form of a spiral sheet the spacing between adjacent structures or adjacent laps of the spiral sheet should be chosen so as to give adequate heat transfer whilst minimising the amount of heat conducting material, e.g. metal, used for the purpose.

In order to increase the temperature of liquid flowing through the pipework and also vapour passing through the ducts, it is possible to attach electrical resistance heaters (e.g. in the form of metal tube enclosing electric elements) to the supporting structure, e.g. sheet or plate. Such electrical resistance heaters which of course should be electrically insulated from the structure can be spaced at regular intervals throughout the supporting structure or if desired only at certain positions on the supporting structure.

It will be appreciated that more than one continuous pipework supported on a structure can be used in any one heat exchanger, thus enabling more than one liquid to be subjected to heat exchange. If two pipeworks are required then one convenient arrangement would be the use of a sheet or plate as the supporting structure with one face supporting one pipework and the other face supporting the other pipework.

The above described heat exchangers are particularly designed for cases where solid material containing a vapour is housed in the heat exchanger adjacent to, but external of the ducts. In such cases the vapour is driven off from the solid, passing through the pervious ducts and out through an outlet, by the heat given up by liquid circulating through the pipework.

The invention is now described with reference to the drawings in which

Fig. 1 is a perspective view part broken away of one form of heat exchanger; and

Fig. 2 is a perspective view of part of an alternative form of heat exchanger.

Referring to Fig. 1 the outer container houses a number of parallel sheets, one of which is shown at 2. Soldered to each of these sheets is a pipework of serpentine shape, two portions of which are shown at 4. Adjacent to the bulk of the pipework are a series of porous ducts, two of which are shown at 3. These consist of wire gauze shaped substantially as half cylinders and are fixed onto the sheets 2 so as to enclose the parallel portions of the serpentine pipework 4, but leaving a small space between the pipework and the gauze.

The ends of each pipework are connected in parallel by manifolds 6 and 7, one of which is the inlet 6 and the other the outlet 7 for liquid flowing through the pipework 4. There is an outlet for vapour at 8.

The space between each sheet 2 is filled with a solid material 5 which may for example be an adsorbent such as zeolite.

The heat exchanger operates by passing heated liquid through the inlet 6 and out of the outlet 7 wherein heat will be transferred to the solid material 5. Any vapour present therein, e.g. water vapour, will be heated and some of it will be vaporised passing through the wire gauze ducts 3 and finally leaving the container 1 through the outlet 8.

In the alternative embodiment shown in Fig. 2 the continuous serpentine pipework 13 is supported on a coiled sheet 10. There are an inlet manifold 11 and an outlet manifold 12 for the pipework 13. Adjacent to the vertical portions of the pipework 13 there are pervious ducts made of half cylinders of wire gauze, two of which are shown at 14. These ducts 14 are welded onto the coiled sheet 10 leaving half cylindrical ducts adjacent to the pipework.

In the interest of clarity the presence of solid material has been omitted but it can be readily appreciated that such material is inserted in between the coils of the sheet 10. It is supported at the bottom by the bottom wall of the outer container which also in the interest of clarity has been omitted. This outer container will preferably be of cylindrical shape and will be provided with a vapour outlet near the top. This embodiment works in an identical manner to that shown in Fig. 1.

Claims

1. A heat exchanger comprising a structure supporting a continuous pipework through which liquid can pass, ducts with pervious walls spaced from and adjacent to the pipework, the structure and pipework being made of heat conducting material and means capable of housing solid material adjacent to, but external of the ducts.

2. A heat exchanger according to claim 1 wherein the pipework is of serpentine shape.

3. A heat exchanger according to either of claim 1 and 2 wherein the ducts are made of wire mesh or gauze.

4. A heat exchanger according to any one of the preceding claims wherein the structure is a sheet, strip or plate.

5. A heat exchanger according to any one of the preceding claims wherein the ducts are made of heat conducting material.

6. A heat exchanger according to any one of the preceding claims wherein electrical resistance heaters are attached to the supporting structure.

7. A heat exchanger according to any one of the preceding claims wherein a plurality of sheets, strips or plates substantially parallel to one another on which the pipework is supported are housed in a container whereby said solid material is housed between each sheet, strip or plate and the ducts.

8. A heat exchanger according to any one of claims 1 to 6 wherein a spiral sheet on which the pipework is supported is housed in a container and solid material is housed between the coils of the spiral sheet.

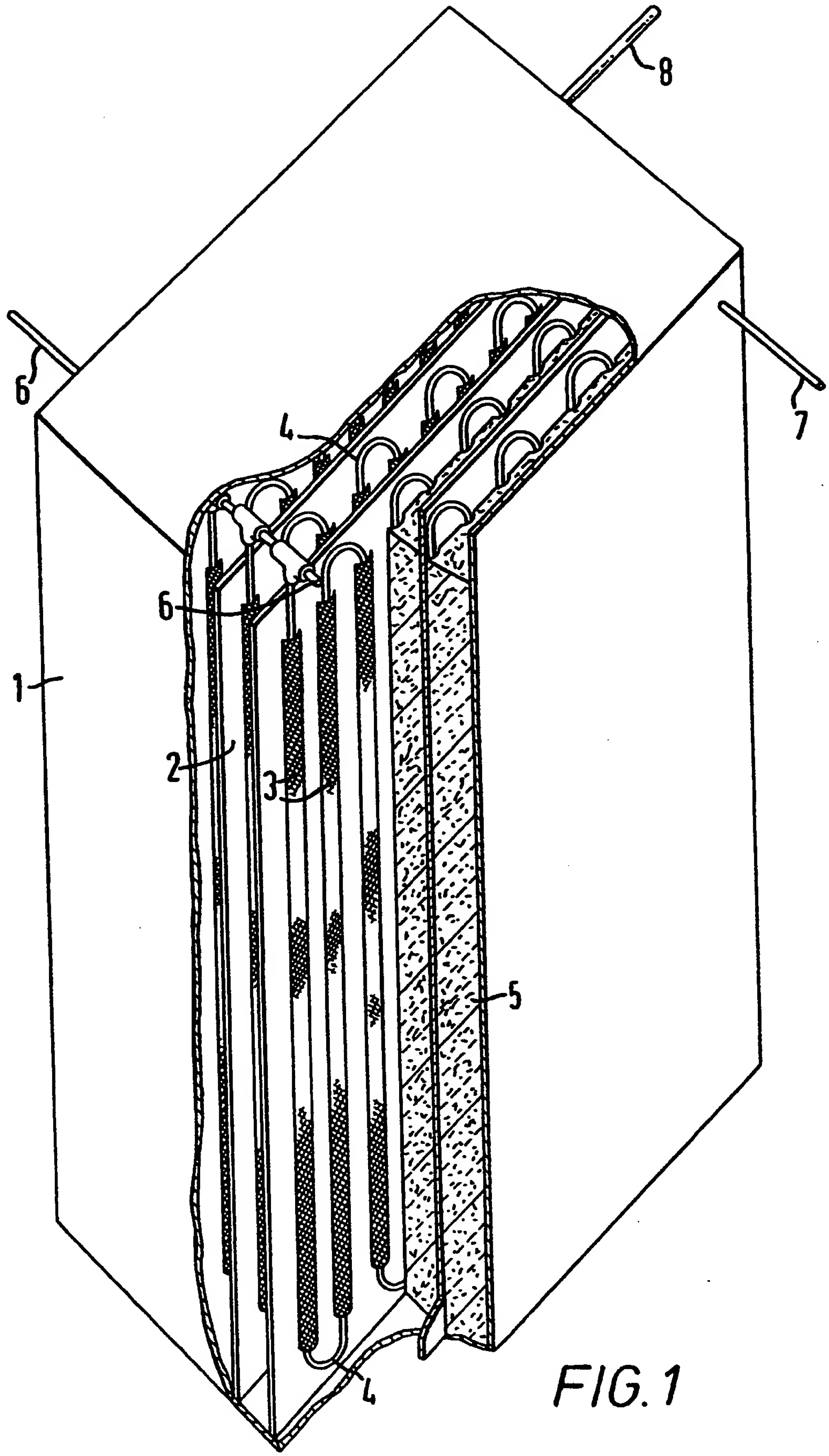

FIG.1

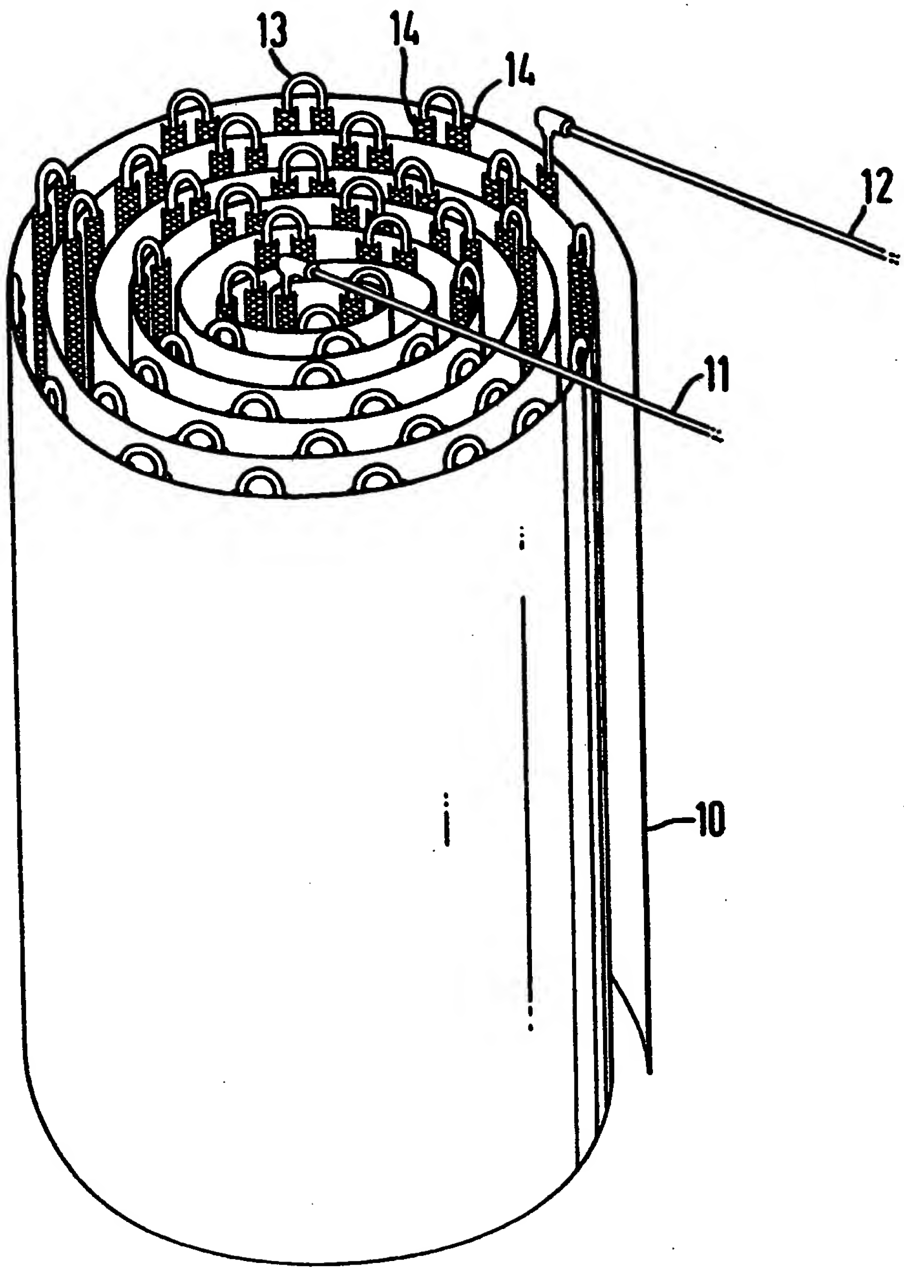

FIG. 2